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8. (As Filed) The method for verifying the purported identity of a target individual as recited in claim 1, further comprising obtaining a number of authorization tissue spectra from an individual, said number of authorization tissue spectra being greater than two.

9. (As Filed) The method for verifying the purported identity of a target individual as recited in claim 1, wherein said target spectrum is added to said authorization spectra after said verification.

10. (As Filed) The method as recited in claim 1, wherein said number of measurement wavelengths is greater than four, further comprising calculating an inter-person spectral distance between said authorized spectra of said verified individuals at said wavelengths, wherein said wavelengths are selected at least in part to maximize said inter-person spectral differences.

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11. (As Filed) The method as recited in claim 10, wherein said number of authorization tissue spectra is greater than four, further comprising calculating an intra-person spectral distance between said authorization spectra for an individual at said wavelengths, wherein said wavelengths are selected at least in part to minimize said intra-person spectral differences.

12. (As Filed) The method as recited in claim 1, wherein said tissue spectra include near-infrared wavelengths.

13. (As Filed) The method as recited in claim 12, wherein said tissue spectra includes a substantial spectral contribution from subcutaneous blood.

Appendix is provided in which the changes to the claims are highlighted by underlining added material and by enclosing deleted material in square brackets.

1. Information Disclosure Statement

Although the return-receipt postcard indicates receipt of the cited references with the IDS by the Patent Office, they appear not to have been forwarded to the Examiner. Accordingly, a new IDS is being submitted under separate cover, together with a copy of the references cited. Applicants request that the Examiner confirm that the references cited therein have been considered by initialing beside the references on modified PTO-1449, and request that the references be cited on the face of any resulting patent.

2. §112 Rejection

The rejection of Claim 23 under §112 has been obviated by canceling the words "about."

3. Prior-Art Rejections

The claims have been amended to better characterize the invention. The manner in which spectral data are obtained has been limited to require that tissue spectral data from subepidermal tissue be obtained by applying a plurality of optical wavelengths to the subepidermal tissue and measuring a plurality of wavelengths emanating from the tissue. Such limitations are disclosed, for example, at p. 14, ll. 1 – 3 of the specification (see also p. 5, lines 19-23).

The manner in which the target individual's identity is verified has been limited to require confirming consistency of a difference calculated between the target tissue spectral data and authorization tissue spectral data with a database having a plurality of intra-patient difference spectra for the target individual. Such limitations are

disclosed, for example, at p. 22, l. 10 – p. 23, l. 17. Calculation of the "difference" between the target tissue spectral data and authorization tissue spectral data as now recited is intended to be construed broadly as defined in the specification. In particular, the "difference" includes performing a subtraction between the spectral data (Application, p. 22, l. 14), determining an element-by-element ratio between the spectral data (*id.*, p. 22, l. 19), and other mathematical operations of a similar nature (*id.*, p. 22, ll. 20 – 21).

The specification explains that population of the database with intra-patient difference spectra may be achieved by sampling one or more people multiple times each (*id.*, p. 23, ll. 1 – 2). This permits the database to account for expected changes in a person's physiology, in or across spectroscopic measurement device, and in the measurement environment (*id.*, p. 23, ll. 2 – 5). There are various additional advantages that ensue from the combination of limitations, including a reduced number of spectral measurements compared with the prior art, in addition to accuracy and repeatability due to the selection of spectra that are unique to the person whose stored data are being used for comparison (*id.*, p. 22, l. 22 – p. 23, l. 10).

As discussed in more detail below, he combination of limitations now recited in each of the independent claims is neither taught nor suggested by the cited prior art. Applicants note initially that much of the prior art cited in the Office Action is directed to the use of *<u>spatially</u> distributed characteristics* in performing identifications in the form of spatial fingerprint distributions, spatial distributions of vascular structure, spatial distributions of facial features, spatial distributions of bone structure, and the like. This is in marked contrast to the pending claims, which instead require confirming consistency of a spectral difference with a database having a plurality of intra-patient difference *spectra*. Rather than rely on spatial distribution of characteristics, the claims recite a specific method of performing a comparison of *spectral* distributions for identification purposes in a simple manner that is neither disclosed nor suggested in the cited art (*see id.*, p. 21, ll. 14 – 19). Such spectral distributions may contain information

related to the *composition* of the tissue, in addition to other information (*id.*, p. 20, 19 – 22).

a. Ott

Claims 1, 2, 5, 7, and 8 stand rejected under 35 U.S.C. §102(b) as anticipated by U.S. Pat. No. Re29,008 ("Ott"); Claim 14 stands rejected under 35 U.S.C. §103(a) as unpatentable over Ott in view of U.S. Pat. No. 6,317,507 ("Dolfing"); and Claim 19 stands rejected under 35 U.S.C. §103(a) as unpatentable over Ott in view of U.S. Pat. No. 5,559,504 ("Itsumi").

Ott teaches the use of *sonic* energy in making identifications (Ott, Col. 3, ll. 7 – 12). Since all of the claims are now limited to the application of *optical* wavelengths, it is believed that the claims are patentable over Ott.

b. Prokoski

Claims 1, 2, 5 – 8, and 12 – 14 stand rejected under 35 U.S.C. §102(b) as anticipated by U.S. Pat. No. 5,163,094 ("Prokoski"); and Claims 15 – 17 stand rejected under 35 U.S.C. §103(a) as unpatentable over Prokoski in view of U.S. Pat. No. 4,944,021 ("Hoshino").

Prokoski teaches the use of thermograms to identify individuals from biosensor data (Prokoski, Col. 3, ll. 19 – 23). Such thermograms reflect data related to the *spatial* structural configuration of blood vessels beneath skin, as well as spatial structural configurations of bone and cartilage. It is because of this focus on spatially derived structural identifications that Prokoski teaches identifying specific elemental shapes as providing a "signature" of an individual used in confirming identity (*id.*, Col. 3, ll. 38 – 42).

Prokoski does not teach or suggest verifying identity by confirming consistency with a database having a plurality of intra-patient difference spectra as the

claims now require. For at least this reason, it is believed that the claims are patentable over Prokoski.

c. Stoianov

Claims 1 – 4 stand rejected under 35 U.S.C. §102(b) as anticipated by U.S. Pat. No. 5,761,330 ("Stoianov").

Stoianov teaches the use of optical-digital hybrid techniques for automating fingerprint verification to identify an individual (Stoianov, Col. 1, ll. 6 – 9). In performing such identifications, Stoianov simply uses the well-known technique of comparing spatial fingerprint-pattern structures with a database of recorded fingerprint patterns (*id.*, Col. 5, ll. 27 – 39). As such, it is limited to disclosing the use of a technique based on spatially distributed characteristics for performing the identification of individuals.

Stoianov does not teach or suggest verifying identity by confirming consistency with a database having a plurality of intra-patient difference spectra as the claims now require. For at least this reason, it is believed that the claims are patentable over Prokoski.

d. Toyoda

Claims 1, 10, 11, and 14 stand rejected under 35 U.S.C. §102(e) as anticipated by U.S. Pat. No. 5,999,637 ("Toyoda").

Toyoda is also limited to disclosing identifications based on spatially distributed characteristics, and focuses particularly on the use of fingerprint identifications (Toyoda, Col. 4, ll. 63 – 66), as acknowledged in the Office Action.

Toyoda does not teach or suggest verifying identity by confirming consistency with a database having a plurality of intra-patient difference spectra as the

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claims now require. For at least this reason, it is believed that the claims are patentable over Toyoda.

e. Messerschmidt, Robinson, and Peterson

Claims 1, 12, 13, and 19 – 23 stand rejected under 35 U.S.C. §103(a) as unpatentable over the combination of U.S. Pat. No. 5,655,630 ("Messerschmidt"), U.S. Pat. No. 4,975,581 ("Robinson"), and U.S. Pat. No. 6,330,346 ("Peterson"); Claims 15 – 17 stand rejected under 35 U.S.C. §103(a) as unpatentable over this combination further in view of Hoshino; and Claim 18 stands rejected under 35 U.S.C. §103(a) as unpatentable over this combination further in view of Hoshino and Toyoda.

Messerschmidt is cited for its disclosure of obtaining spectral data from tissue and Peterson is cited for its use of spectral information in performing identifications (Office Action, p. 15). While Messerschmidt discloses comparison of spectral distributions, it provides no suggestion that such a comparison may be used for identity-verification purposes. This recognition is instead the product Applicants' insight. Furthermore, Applicants respectfully disagree with the assertion in the Office Action that Peterson teaches using the spectral information "in a manner very similar to that of Messerschmidt" (*id.*, p. 15).

In particular, Peterson is like some of the other prior art references discussed above in that its teachings are limited to the use of *spatially* distributed characteristics in performing identifications. This is evident not only from its reference to "illuminating subcutaneous structure and/or conditions" for comparison with stored indicia (Peterson, Col. 1, ll. 16 – 23), but also from the description of the device used:

> As seen in FIG. 1, a plurality of infrared light-emitting diodes are arranged, as is explained in detail hereinafter, such that they provide relatively even and continuous illumination of the object. The sensor array which is spaced by the mask and located beneath the field of view limiting holes assures that there is no cross-feed which might distort the image.
> (*Id.*, Col. 2, ll. 49 – 55).

The emphasis by Peterson on collection of an "image" and the need to avoid distortions by cross talk makes it clear that it is describing a method for collecting spatially distributed structural information. There is nothing in Peterson that suggests confirming consistency with a database having a plurality of intra-patient difference spectra in verifying identity.

Applicants thus continue to traverse the assertion in the Office Action that there is a motivation to combine the teachings of Messerschmidt and Peterson. There is no suggestion in these references that it would be beneficial to use the spectral-distribution determinations of Messerschmidt with the spatial-distribution determinations of Peterson. Explained differently, Messerschmidt describes a *non-imaging* system that uses the measurement of multiple wavelengths of light as the input data to a spectrum analyzer (Messerschmidt, Figs. 1 and 2). In contrast, Peterson's system is an *imaging* system based on an array of source and detector elements (Peterson, Col. 2, l. 58 and Fig. 1).

Indeed, Applicants believe that at the time of their invention, it would not have been clear to one of skill in the art why or how an identification technique based on the spectral comparisons as embodied in the claims could work. For example, the specific illustration provided by Messerschmidt is concerned with using the spectrographic techniques for quantifying glucose levels in individuals (Messerschmidt, Col. 5, ll. 49 – 54). Knowing this glucose level is insufficient to distinguish large groups of individuals (and indeed seems better for grouping them rather than discriminating among them), particularly since glucose levels vary over time in response to metabolic functions. It was only the product of Applicants' insight that identified how confirming consistency with a database having a plurality of intra-patient difference spectra could be used for verifying identity on an individual-by-individual basis and over time. This is underscored by the omission of any description of such a database in Messerschmidt.

f. U.S. Pat. No. 6,122,042 ("Wunderman")

In the telephone interview held on November 8, 2002, the Examiner indicated that he viewed Wunderman as relevant to the patentability of the claims, even though it had not previously been cited in an Office Action. Accordingly, Applicants make the following remarks regarding Wunderman in the interest of advancing prosecution of the application.

Wunderman discloses a method of spectroscopy that is based on optical *nonlinearities* of a material (Wunderman, Col. 9, ll. 22 – 25) and suggests that such optical nonlinearities may be used as a means to identify individuals (*id.*, Col. 37, ll. 55 56). The nonlinear characteristics described by Wunderman are manifested by the fact that wavelength *combinations* are used to derive the nonlinearities:

> When a conventional single wavelength is applied to a material, its intensity must be sufficient to begin to "saturate" some occupied density of states at the energy. But since only a small non-linearity results from a large applied intensity, the non-linearity is thus difficult to resolve. However, when the detected interaction effects of two overlapping wavelengths (A and B) are measured, their algebraically, detected sum (A separate + B separate), and their combined superimposed sum (A + B, simultaneous) can readily be compared to say, 16-bit to 24-bit accuracy.
> (*Id.*, Col. 9, ll. 25 – 35).

These wavelength combinations are then achieved by illuminating combinations of light sources (*see generally, id.,* Col. 9, ll. 13 – 57), with Wunderman emphasizing that the use of wavelength combinations as part of its "IDEA" probe is "essential" to its disclosure:

> The IDEA probe can simultaneously apply any or all combinations of excitation wavelengths and search for nonsuperposition whenever the difference between the combined-applied detected signal and the separately applied algebraically summed signals does not equal zero.... The non-zero difference for the 32,767 comparisons thus provides a signature of that material. This measurement of optical non-linearity via a deviation from zero is a new and powerful form of spectroscopy *that forms an essential feature of this invention.*
> (*Id.*, Col. 10, l. 64 – Col. 11, l. 9, emphasis added).

In marked contrast, Applicants have identified that it is possible to perform the positive verification by confirming consistency of with a database having a plurality of intra-patient difference spectra, thereby avoiding the complexity advocated by Wunderman in deriving nonlinear characteristics.

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In the telephone interview on November 8, 2002, the Examiner indicated that he viewed the following language in Wunderman as pointing to a motivation to combine it with other prior art:

> A simple example of an identification process as discussed in this invention is articulated below to exemplify how one discrimination algorithm works. Numerous other algorithmic methods may also be used, and typically more esoteric than the description here.
> (Wunderman, Col. 38, ll. 32 – 36).

The specific discrimination algorithm referred to in this language provides an example of a numerical technique that may be used to perform a comparison of the tissue optical nonlinearities as manifested in the multiple-wavelength comparisons that are essential to Wunderman's method (as well as a comparison of hand geometry). The cited language may properly be read as indicating that other numerical techniques may be used to perform the comparison and that Wunderman is not to be limited by the specific numerical technique disclosed. There is, however, nothing in the statement to suggest that an identification can be performed using anything other than the optical nonlinearities that Wunderman elsewhere identifies as "essential" to its method (*id.*, Col. 11, ll. 6 – 9), regardless of the algorithm used to compare them. Indeed, to confirm consistency with a database having a plurality of intra-patient difference spectra as now recited in the claims would change the principle of operation of Wunderman, a factor that strongly indicates it is *not* appropriately combined with other references (*see* MPEP 2143.01).

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 303-571-4000.

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Respectfully submitted,

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APPENDIX: VERSION WITH MARKINGS TO SHOW CHANGES MADE

The changes to the claims made by the foregoing Amendment are highlighted by underlining added material and enclosing deleted material in square brackets.

Claims 2, 5, and 17 have been canceled; Claims 1, 3, 4, 14, 15, 18, 19, and 23 have been amended; and Claims 24 – 29 have been added so that the pending claims read as follows:

1. (Amended) A method for verifying the purported identity of a target individual utilizing a number of authorization tissue spectral data from verified individuals having known identities, said spectral data having a plurality of measurement wavelengths, comprising the steps of:

obtaining target tissue spectral data from subepidermal tissue of said target individual**[s, said target tissue spectral data having a number of measurement wavelengths]** by applying a plurality of optical wavelengths to the subepidermal tissue and measuring a plurality of wavelengths emanating from the tissue; and

positively verifying said target individual's purported identity by confirming consistency of a difference calculated between the target tissue spectral data and **[comparison of]** authorization tissue spectral data **[and said target tissue spectral data relative to a preselected threshold]** with a database having a plurality of intra-patient difference spectra for the target individual.

2. (Canceled).

3. (Amended) The method for verifying the purported **[identify]** identity of a target individual as recited in claim **[2]** 1, further evaluating the difference calculated wherein said evaluation is done by a model that identifies between patients' differences.

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4. (Amended) The method for verifying the purported **[identify]** identity of a target individual as recited in claim **[2]** 1, wherein said differences are processed through a model to determine the significance of identified differences.

5. (Canceled).

6. (As Filed) The method for verifying the purported identity of a target individual as recited in claim 1, wherein said number of verified individuals is equal to one.

7. (As Filed) The method for verifying the purported identity of a target individual as recited in claim 1, wherein said number of verified individuals is greater than one.

8. (As Filed) The method for verifying the purported identity of a target individual as recited in claim 1, further comprising obtaining a number of authorization tissue spectra from an individual, said number of authorization tissue spectra being greater than two.

9. (As Filed) The method for verifying the purported identity of a target individual as recited in claim 1, wherein said target spectrum is added to said authorization spectra after said verification.

10. (As Filed) The method as recited in claim 1, wherein said number of measurement wavelengths is greater than four, further comprising calculating an inter-person spectral distance between said authorized spectra of said verified individuals at said wavelengths, wherein said wavelengths are selected at least in part to maximize said inter-person spectral differences.

11. (As Filed) The method as recited in claim 10, wherein said number of authorization tissue spectra is greater than four, further comprising calculating an intra-person spectral distance between said authorization spectra for an individual at said wavelengths, wherein said wavelengths are selected at least in part to minimize said intra-person spectral differences.

12. (As Filed) The method as recited in claim 1, wherein said tissue spectra include near-infrared wavelengths.

13. (As Filed) The method as recited in claim 12, wherein said tissue spectra includes a substantial spectral contribution from subcutaneous blood.

14. (Amended) A method for verifying the purported identity of a target individual comprising the steps of:

obtaining a **[number]** plurality of authorization tissue spectra from subepidermal tissue of each of a number of verified individuals**[, said authorization tissue spectra having a plurality of measurement wavelengths]** by applying a plurality of optical wavelengths to the subepidermal tissue of the verified individuals and measuring a plurality of wavelengths emanating from the tissue, said verified individuals having identities;

determining intra-patient difference spectra determined from the plurality of authorization tissue spectra for each of the verified individuals;

obtaining a target tissue spectrum from subepidermal tissue of said target individual **[, said target tissue spectrum having a number of measurement wavelengths]** by applying the plurality of optical wavelengths to subepidermal tissue of the target individual;

performing discriminant analysis on said target tissue spectrum and said **[authorization tissue]** intra-patient difference spectra for said purported identity; and

positively verifying said target purported identity if, and only if, said discriminant analysis is satisfied.

15. (Amended) A system for verifying the purported identity of a target individual comprising:

an authorized database including a plurality of intra-patient difference near-infrared tissue spectra for each of a plurality of authorized persons;

means for obtaining a near-infrared tissue spectrum and purported identity from said target individual by applying a plurality of optical wavelengths to subepidermal tissue of the target individual and measuring a plurality of wavelengths emanating from the tissue;

means for discriminating between said target individual near-infrared spectrum and said authorized persons near-infrared spectra**[, utilizing said authorized person database and said target spectrum]** by confirming consistency of a difference calculated between the target individual near-infrared spectrum and an authorization near-infrared tissue spectrum with the intra-patient difference near-infrared tissue spectra of the authorized database; and

means for indicating if said target individual purported identity is correct.

16. (As Filed) The system as recited in claim 15, wherein said discriminating means utilizes said target purported identity.

17. (Canceled).

18. (Amended) The system as recited in claim **[17]** 15, wherein **[said near-infrared spectra includes a plurality of measurement values, each associated with a wavelength, wherein said means for discrimination includes means for calculating a spectral difference between any of said spectra, and]** said means for

discrimination includes means for selecting a plurality of said wavelengths, such that spectral differences between said spectra of said authorized persons is maximized.

19. (Amended) A system for verifying the purported identify of a target individual comprising:

a computer including an input device and an output device;

a database including <u>a plurality of intra-patient difference</u> near-infrared tissue spectra for <u>each of</u> a plurality of authorized persons;

means for obtaining a near-infrared tissue spectr<u>um</u>**[a]** from said target individual, including a near-infrared radiation source for projecting **[near-infrared radiation]** <u>a plurality of near-infrared optical wavelengths</u> subcutaneously and a near-infrared spectrometer for measuring subcutaneous near-infrared intensity over a plurality of wavelengths; and

a program running in said computer for discriminating between said target individual near-infrared spectrum and said authorized persons near-infrared spectra **[utilizing said authorized person database and said target spectrum]** <u>by confirming consistency of a difference calculated between the target individual near-infrared tissue spectrum and an authorization near-infrared tissue spectrum with the intra-patient difference near-infrared tissue spectra of the database</u>.

20. (As Filed) The system of claim 19, wherein said means for obtaining a near-infrared tissue spectra includes an input element and an output element coupled to said tissue via an index-matching medium.

21. (As Filed) The system of claim 20, wherein said index-matching medium comprises a chlorofluorocarbon polymer.

22. (As Filed) The system of claim 21, wherein said polymer includes chlorotrifluoroethylene.

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23. (Amended) The system of claim 20, wherein said index-matching medium has a refractive index between **[about]** 1.30 and **[about]** 1.45.

24. (New) The method recited in claim 1 wherein applying the plurality of optical wavelengths comprises applying a spectral band of the optical wavelengths.

25. (New) The method recited in claim 14 wherein applying the plurality of optical wavelengths comprises applying a spectral band of the optical wavelengths.

26. (New) A system for verifying the purported identity of a target individual comprising:

an authorized database including a plurality of intra-patient difference near-infrared tissue spectra for each of a plurality of authorized persons;

an optical source adapted to apply a plurality of optical wavelengths to subepidermal tissue of the target individual;

a spectrometer adapted to obtain a near-infrared tissue spectrum from the target individual by measuring a plurality of wavelengths emanating from the tissue;

a comparator adapted to discriminate between the target individual near-infrared spectrum and the authorized persons near-infrared spectra by confirming consistency of a difference calculated between the target individual near-infrared spectrum and an authorization near-infrared tissue spectrum with the intra-patient difference near-infrared tissue spectra of the authorized database; and

an indicator adapted to indicate if a purported identity of the target individual is correct.

27. (New) The system of claim 26 wherein the optical source and spectrometer are coupled to the tissue via an index-matching medium.

28. (New) The system of claim 27, wherein the index matching medium comprises a chlorofluorocarbon polymer.

29. (New) The system of claim 28, wherein the polymer includes chlorotrifluoroethylene.